

NEW METHOD FOR BATCH TESTING OF RED TART CHERRIES FOR THE PRESENCE OF PITS

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ABSTRACT

A method was developed to determine the number of pits in samples of red tart pitted (RTP) cherries. The method is based on pulping the sample in a modified kitchen blender and detecting pits either from the noise of pits rattling in the blender or by pouring the resulting pulp through a trap designed to retain the pits. The method is more rapid and convenient than the present method and allows the recovery of tested product as juice. Screening missed a total of 1½ pits when 1 pit was added to each of 233 samples consisting of fresh, fresh frozen, individually quick frozen and bulk frozen RTP cherries.

INTRODUCTION

Red tart pitted (RTP) (Montmorency cultivar) cherries form a major crop in U.S. agriculture, accounting for a total production of 86,000 metric tons (190 million lb) in 1991 (Binde *et al.* 1992). Substantially all (98%) of this crop is processed and sold frozen or canned. The Agricultural Marketing Service (AMS) of the U.S. Department of Agriculture (USDA) offers a voluntary inspection, grading, and USDA certification service, which covers frozen or canned RTP cherries. In 1991 almost 27,000 metric tons (60 million lb) were included in this grading program, requiring the testing of almost 25,000 samples. AMS carried out additional inspections of nonfrozen cherries, as did the industry itself of both frozen and nonfrozen cherries. Certification thus comprised a substantial effort.

The detection of pits or pit fragments remaining in pitted fruit, and in particular cherries, has been the subject of research and application for almost 30 years. For largely commercial reasons, such work has emphasized on-line, rather than batch, detection. Several methods have shown promise and are actively being pursued or even commercialized, although with limited success.

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Allen *et al.* (1966) patented a light (visible or IR) scattering method, which was investigated by Law (1973), who found a high, and undesirable, dependence on cherry orientation. This technique is the basis of a spectral reflection technique used in a commercial unit produced by Clayton Durand Manufacturing Co. (Durham, NC) and, it is claimed, is capable of detecting pits in cherries Timm *et al.* (1991). Light transmission was patented by Gillespie and Ricks (1987) and further improved by use of image analysis by Timm *et al.* (1991). Light transmission is the basis of a commercial device manufactured by Agrivision (Davis, CA). X-ray absorption is under investigation by SRS Technologies (1993). Rheological detection of pits was patented by Ross and Crawford (1979). Other methods, in particular weighing, microwave transmission, ultrasound transmission and pit-tube transmission were investigated by Timm *et al.* (1991). None of these methods are fully satisfactory, as shown by continuing work in on-line detection. In any event, detection capability to around 95–96% in the best of cases is not adequate to certify pit removal, as is required in batch tests and towards which the present work is directed.

Fresh cherries are delivered to the processing plant in pallet tanks of cold water after mechanical shake-down from the trees. Following visual sorting to remove extraneous material and obvious defects, cherries are immobilized and depitted by star shaped plungers which pass through them. The cherries are then processed in one of three forms. For bulk 5 + 1 frozen cherries, 30 lb are placed into plastic containers and covered with 1 part granular sugar to 5 parts fruit to protect the cherries from oxidation. The filled containers are then placed into a freezer and held in cold storage. Individually quick frozen (IQF) cherries are flash frozen to a free flowing product resembling marbles, then placed into containers and held in cold storage. Canned cherries are packed in #2 or #10 cans with or without sugar, followed by sterilization through heating.

Inspection may be done on-line in the plant or it may be done on the final packed product. The material to be inspected may thus vary in turgidity, water content, and even state (liquid or solid). From 3 to 29 samples are used, depending on the lot size (each sample contains 567 g or 20 ounces of cherries). For grade certification, the absence of pits is an important factor. For a lot to be of grade A, the overall pit count among all samples tested may not exceed 1 pit per 1,146 g (40 oz) with no single sample containing more than 2 pits. For grade B, the overall pit count must be less than 1 pit per 850 g (30 oz) and no sample may contain more than 3 pits. For grade C the pit count must be less than 1 pit per 567 g (20 oz) with no per sample restriction. Failing C the lot is termed substandard (USDA 1974). In actual fact, pit count is typically well below that; in 1991 80% by weight of cherries contained less than 1 pit per 3,400 g, while 60% contained less than 1 per 1,300 g for an overall pit count of 1 pit per 5,200 g (Binde *et al.* 1992). The industry would like to reach a consistent level of 1 per 28,300 g (1,000 oz), a level reached currently by over

35% of tested cherries (Binde *et al.* 1992). Testing for such low pit counts at the current levels of confidence will require even larger samples or a greater number of samples than are currently being tested.

The present method of testing for pits is laborious, time consuming, may be subject to error (missed pits) and consumes considerable product, which is usually discarded. A sample of 567 g (1,134 g or 40 oz is also used by the industry), containing at least 100 cherries, is spread single layer on a tray, thawed or partially thawed if needed, and each cherry is individually pressed by hand or instrument to ascertain the absence of pit material. The pitting plungers rarely produce pit fragments, so the test essentially counts whole pits remaining. What is needed is a method that is rapid, convenient, inexpensive in equipment and preferably nondestructive in that the tested sample can be returned to the process stream. This report presents a method substantially satisfying these requirements. In brief, the method consists of pulping the sample in a blender and determining the pit count either by washing the product through a slit strainer, which retains the pits, or by listening for the sound of the pits in the running blender. The pulped cherries can be returned to a cherry juice product line.

MATERIALS AND METHODS

Pitted cherries were obtained from a commercial source, through the offices of an ARS research station at E. Lansing, MI. Lots consisted of 45,000–68,000 g each of fresh cherries (ice packed, shipped overnight and tested within three days of receipt), bulk frozen cherries, IQF cherries (shipped frozen) and fresh canned cherries in #10 cans, packed with 17% syrup. A separate shipment of pits was obtained directly from ARS. To distinguish them from pits already present in the cherries as shipped, the separately received pits were dyed red.

For pulping cherries an Osterizer Cycle Blend blender (Sunbeam Oster Home Appliance Co., Laurel, MS)² was purchased locally. The blades of such a blender are sharpened for kitchen use. To avoid breaking the pits or jamming them against the container walls, all blade edges were ground until the edge was blunted to a width of 2.5 mm. The lower blades were ground to 19 mm in length (Fig. 1). No-load blade speed was measured by a Cole-Parmer photo-tachometer (model 08210, Niles, IL). At the lowest speed setting ("stir") of the blender the blade speed was measured to be 11,500 rpm, the next setting

²Reference to a company and/or product named in this article is only for purposes of information and does not imply approval or recommendation of the product to the exclusion of others which may perform in an equivalent manner.

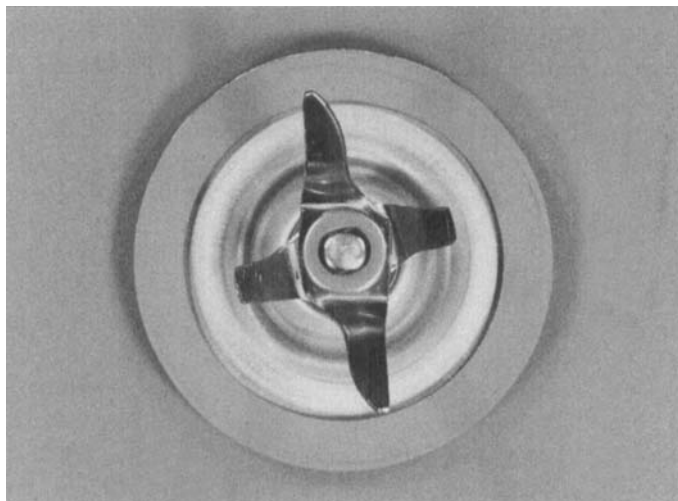


FIG 1. MODIFIED BLENDER BLADES
The edges have been dulled and the lower blades shortened to prevent pits being caught between the blade and the side of the pitcher.

("puree") was measured at 12,600 rpm. For lower speed a reduced voltage was supplied by a Powerstat variable transformer (Superior Electric Co., Bristol, CT). Operation at 9,000 rpm was achieved with 50 volts and a "liquify" setting. When the blender was filled with cherries the speed decreased substantially. However, blade speed under loaded conditions could not be measured as the blades were not visible. All speeds given below refer to unloaded conditions. Some samples were diluted with water before blending. Blending speed and time were chosen to optimize the pulping operation and minimize shattering of pits. A plastic food container (standard part, available locally) was used with the blender; a glass container was not satisfactory, as it caused pits to shatter.

For testing fresh cherries 567 g (20 oz) samples of drained cherries were placed in the blender; 473 ml (1 pint) of water and one pit was added to each sample. The first 26 samples were blended at 9,000 rpm for 1 min. Another 26 samples were pulped at 11,500 rpm. The noise of a pit rattling against the plastic container was listened for by the operator. At the end of 1 min the pulped sample was poured through a slitted trap (Fig. 2) constructed from aluminum. The pulp was rinsed through the trap with flowing water. The number of pits caught in the trap was visually counted.

Canned cherries were tested in a similar way. A total of 60 samples were tested, all at 11,500 rpm, but without added water. However, in this case the cherries as received contained a substantial number of pits. Accordingly, the pits

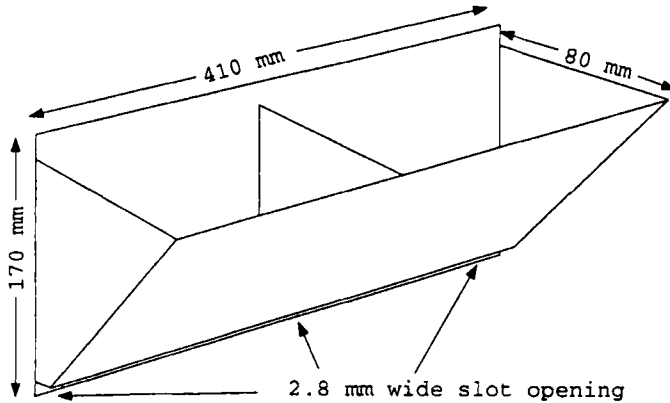


FIG 2. TRAP USED TO RETRIEVE PITS FROM PULPED CHERRIES
Material: 0.16 mm (1/16 in.) aluminum sheet stock.

received from ARS were used as additive only for the first 24 samples, after which recovered and dyed pits from the lot itself were added to the remaining samples.

A total of 49 samples of 5+1 bulk frozen cherries were tested. Five containers were thawed and drained, yielding approximately 5,600 g of cherries per container. One pint water and one dyed cherry pit were added to each 567 g sample, which was blended at 12,600 rpm for 20 s, followed by 40 s at 11,500 rpm. Pits received from ARS were added to the first 12 samples at 1 pit per sample; recovered, dyed pits were added to the remaining 37 samples.

A total of 72 567-g samples of IQF cherries were tested. After thawing, testing proceeded precisely as in the drained bulk frozen samples. Time of processing a set of 12 samples was measured. The sound of pits in the blending jar (or the absence of sound) was listened for, but no records were kept. The trap, shown in Fig. 2, was constructed from 0.16 mm (1/16 in.) thick aluminum sheet stock. Trap length amounted to 41 cm. The trap slot opening, which retained the pits, was 2.8 mm in width.

RESULTS AND DISCUSSION

Cherry pits can be visualized as ellipsoids. Micrometer widths on 50 of the pits as received from ARS yielded 9.4 ± 0.6 , 7.9 ± 0.5 and 6.1 ± 0.4 mm for the three principal axes. The recovered pits yielded 8.4 ± 0.6 , 7.3 ± 0.5 and 5.8 ± 0.4 mm, respectively. Received pits averaged 0.152 g per pit, recovered pits 0.146

g per pit. From an operational point of view, the difference is immaterial, as either type pit is caught by the trap.

The sample pit count and grade, based on the number of nondyed pits recovered, is shown in Table 1. Pit fragments were recorded as found, i.e., no account was taken of their size. It will be seen that grade covered the full range, from A to substandard. The lots had been selected to provide such a wide range. Since the trap opening was 2.8 mm in width, fragments smaller than that presumably could pass through and would not be recovered. Thus the fragment count may well be low.

TABLE 1.
NUMBER OF CHERRY PITS RECOVERED FROM COMMERCIAL
TEST LOTS OF RTP MONTMORENCY CHERRIES

Recovered pits/sample ^a	Product			
	Fresh	Canned	Frozen	IQF ^b
0	49	6	32	39
1	3	18	11	25
2		11	6	4
3		17		4
4		7		
5		1		
Samples, no.	52	60	49	72
Total sample/pit, g	9828	274	1208	907
(ounces)	(346)	(10)	(43)	(32)
Samples with fragments	0	3	1	3
Grade, based on pit count	A	Sub Std.	A	B

^a Added pits not included.

^b Individually quick frozen

Recovery of added pits is shown in Table 2. In all but two cases all added pits were recovered. In one case a pit was lost (presumably shattered), in another a large pit fragment was recovered, for an overall recovery rate of $99.4 \pm 0.5\%$. Using this method 12 samples were processed in 20 min. This time does not include sample weighing, but does include filtering, wash out and pulp removal. The noise of a pit in the blender could be heard every time. This success will, of course, depend on the hearing acuity of the operator. The industry average for RTP cherries amounts to 1 pit per 9 567-g samples. No pit noise should therefore be heard in 8 of every 9 samples tested. If noise rather than screening were to be used, most of the sampled material could be returned as pulped, but nondiluted material.

TABLE 2.
DYED PITS RECOVERED, AFTER ADDITION OF 1 PER SAMPLE

Pits	Product			
	Fresh	Canned	Frozen	IQF ^a
Added	52	60	49	72
Recovered	52	59½ ^b	49	71

^a Individually quick frozen

^b The half pit refers to a recovered fragment

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